IS 6232 (1971): Cast Iron Box Angle Plates [PGD 25: Engineering Metrology]

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UDC 621·753·3 : 531·747 (Third Reprint JUNE 2001) IS : 6232 - 1971
(Reaffirmed 1998)

Indian Standard

SPECIFICATION FOR CAST IRON BOX ANGLE PLATES

Engineering Metrology Sectional Committee, EDC 43; Gauges Subcommittee, EDC 43 : 3 [Ref : Doc : EDC 43 (1872)]

1. Scope - Lays down the requirements for two grades of cast iron box angle plates.

2. Definitions

2.1 *Working Faces* All faces, whether exterior or interior, which are finished by any of the processes mentioned under **4.1** and **4.2**.

2.2 *Tolerance or Flatness* The maximum permissible distance separating two imaginary parallel planes within which the surface under consideration can just be enclosed.

2.3 *Tolerance on Squareness* The maximum permissible distance separating the two imaginary parallel planes within which the surface under consideration can just be enclosed. The imaginary parallel planes are perpendicular to the datum face in question.

2.4 *Tolerance on Parallelism* - The maximum permissible distance separating the two imaginary parallel planes within which the surface under consideration can just be enclosed. The imaginary parallel planes are parallel to the datum face in question

3. Material and Hardness The box angle plates shall be made from close-grained cast iron conforming to Grade 20 or higher of IS : 210 1962 'Specification for grey iron castings (*revised*)' The box angle plates shall have a minimum hardness of 180 *HB*

4. Grades

4.1 There shall be two grades of box angle plates depending upon their accuracies namely, Grade 1 and Grade 2.

4.2 Box angle plates which are hand-scraped on all exterior faces and edges, and conforming to the accuracies specified in Table 2 shall be classified as Grade 1.

4.3 Box angle plates finished by a similar process or by planing or milling on all exterior faces, and conforming to the accuracies specified in Table 3 shall be classified as Grade 2.

5. Dimensions - The recommended dimensions of box angle plates shall be as given in Table 1.

6. Tolerances

6.1 *Grade 1 Box Angle Plates* Grade 1 box angle plates shall comply with the tolerances for flatness of exterior faces, squareness of adjacent faces and parallelism of opposite faces as specified in Table 2.

6.2 *Grade 2 Box Angle Plates* Grade 2 box angle plates shall comply with the tolerances for flatness of exterior faces, squareness of adjacent faces and parallelism of opposite faces as specified in Table 3.

6.3 *Matched Pairs* - Matched pairs of box angle plates shall comply with tolerances equivalent to those shown in col 4 of Tables 2 and 3. The form, dimensions and positions of slots shall be the same on each plate of matched pair.

7. Designation

7.1 The designation of the box angle plates shall consist of its size number, the grade and the number of this standard.

Example:

A size 6 Grade 1 Box Angle Plate shall be designated as :
Box Angle Plate 6-Gr 1 IS : 6232

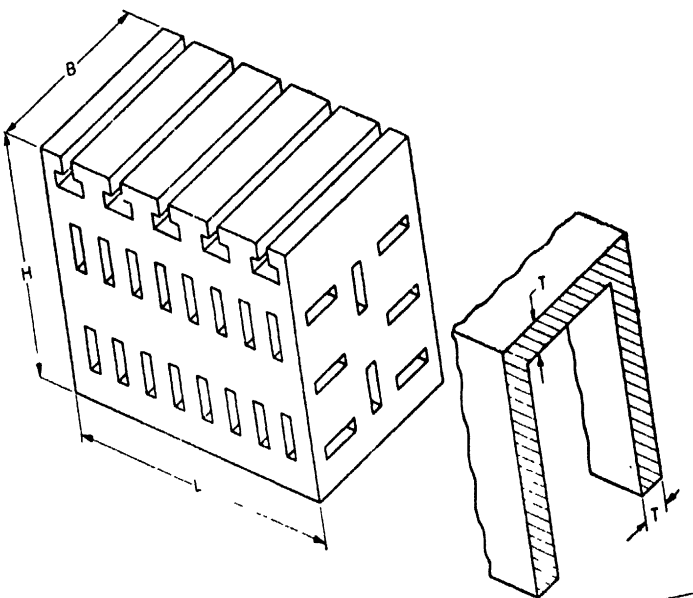
Adopted 30 June 1971 Gr 4

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

TABLE 1 RECOMMENDED GENERAL DIMENSIONS FOR BOX ANGLE PLATES

(*Clause* 5)

All dimensions in millimetres.



Size No.	L	B	H	T* Min
(1)	(2)	(3)	(4)	(5)
1	125	75	100	13
2	175	100	125	13
3	250	150	175	16
4	350	200	250	22
5	450	300	350	22
6	600	400	450	25

*These minimum thicknesses apply to sides other than those incorporating T-slots. Where T-slots are provided, these shall comply with IS : 2013-1962 'Dimensions for T-slots' and the thickness shall be increased proportionately.

†*Since revised.*

TABLE 2 TOLERANCES FOR GRADE 1 BOX ANGLE PLATES

(*Clauses* 4.2, 6.1 *and* 6.3)

All dimensions in millimetres.

Size No.	Flatness of Working Faces	Squareness of Adjacent Faces	Parallelism of Opposite Working Faces
(1)	(2)	(3)	(4)
1	0·005	0·010	0·013
2	0·005	0·013	0·015
3	0·008	0·015	0·018
4	0·008	0·018	0·020
5	0·010	0·018	0·020
6	0·010	0·020	0·023

TABLE 3 TOLERANCES FOR GRADE 2 BOX ANGLE PLATES

(*Clauses* 4 3, 6 2 *and* 6.3)

All dimensions in millimetres.

Size No.	Flatness of Working Faces	Squareness of Adjacent Faces Over *H*	Parallelism of Opposite Working Faces
(1)	(2)	(3)	(4)
1	0·025	0 050	0·063
2	0 025	0 050	0·063
3	0 038	0 075	0·088
4	0·038	0 075	0·088
5	0 050	0 100	0·113
6	0·050	0 100	0·113

AMENDMENT NO. 1 DECEMBER 1978

TO

IS:6232-1971 SPECIFICATION FOR CAST IRON BOX ANGLE PLATES

Alterations

(*Page 1, clause 3, line 2*) - Substitute "IS:210-1970 'Specification for grey iron castings (*second revision*)'" *for* "IS:210-1962 'Specification for grey iron castings (*revised*)'".

(*Page 2, Table 1, foot-note with '*' mark, line 2*) - Substitute "IS:2013-1974 'Dimensions for T-slots (*first revision*)'" *for* "IS:2013-1962 'Dimensions for T-slots'".

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APPENDIX A

(*Clause* 8.2)

METHOD OF TESTING SURFACES

A-1. Flatness

A-1.1 *The Use of a Sensitive Level* - The best method which may be recommended for testing the flatness of surfaces from first principles is by means of a sensitive level. This method is not only applicable to surfaces of any size but the sensitivity of the test may easily be varied to suit the purpose in view. As regards the ultimate accuracy which may be attained by this method, it has been proved capable of detecting errors in flatness as small as 0·000 1 mm in a lapped plate about 300 mm in diameter.

A-1.2 The method of assessing the error of flatness of a surface by using a spirit level is to measure the contour of the surface along a number of lines which form a network covering the total surface. The

TABLE 1 RECOMMENDED GENERAL DIMENSIONS FOR BOX ANGLE PLATES

(*Clause* 5)

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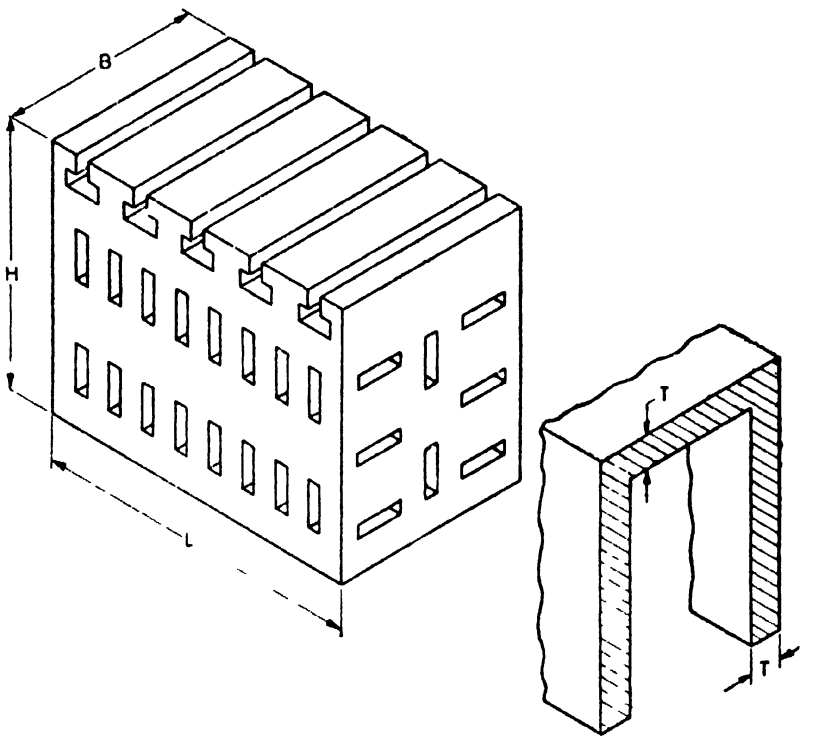

Size No.	L	B	H	T* Min
(1)	(2)	(3)	(4)	(5)
1	125	75	100	13
2	175	100	125	13
3	250	150	175	16
4	350	200	250	22
5	450	300	350	22
6	600	400	450	25

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*Since revised.

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(*Clauses* 4 2, 6.1 *and* 6 3)

All dimensions in millimetres.

Size No.	Flatness of Working Faces	Squareness of Adjacent Faces	Parallelism of Opposite Working Faces
(1)	(2)	(3)	(4)
1	0 005	0 010	0 013
2	0 005	0 013	0·015
3	0 008	0·015	0 018
4	0 008	0 018	0·020
5	0 010	0 018	0 020
6	0 010	0 020	0 023

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TABLE 3 TOLERANCES FOR GRADE 2 BOX ANGLE PLATES

(*Clauses* 4.3, 6.2 *and* 6.3)

All dimensions in millimetres

Size No.	Flatness of Working Faces	Squareness of Adjacent Faces Over *H*	Parallelism of Opposite Working Faces
(1)	(2)	(3)	(4)
1	0.025	0.050	0.063
2	0.025	0.050	0.063
3	0.038	0.075	0.088
4	0.038	0.075	0.088
5	0.050	0.100	0.113
6	0.050	0.100	0.113

8. General Requirements

8.1 *Stress Relief* — After being cast and rough machined, the box angle plates shall be given a suitable heat treatment to relieve internal stress before being finished.

8.2 *Bearing Area* Plates which are finished by hand-scraping shall have an area of high spots (bearing area) not less than 20 percent. A method of determining the bearing area is given in Appendix A.

8.3 *Defects* The material shall be sound and free from blow holes and porous patches except for such minor defects as may be repairable. Minor defects in the angle plates shall be repaired by plugging with the material of similar composition to that from which the angle plate is made. All sharp edges shall be removed.

8.4 The box angle plates shall be within the tolerances specified for tolerance on flatness and any departure from flatness shall be in the nature of concavity and not a convexity.

9. Marking Each box angle plate shall be legibly and permanently marked with the manufacturer's name or trade-mark, the grade of the plate and such other identification marks. The marking shall be such that it does not affect the accuracy of the plate.

9.1 *ISI Certification Marking* Details available with the Indian Standards Institution, New Delhi.

10. Packing During storage and transit, all finished surfaces and edges of the box angle plates shall be protected against climatic conditions by being covered with a suitable corrosion preventive preparation. The angle plates shall be packed according to the best trade practice.

APPENDIX A

(*Clause* 8.2)

METHOD OF TESTING SURFACES

A-1. Flatness

A-1.1 *The Use of a Sensitive Level* — The best method which may be recommended for testing the flatness of surfaces from first principles is by means of a sensitive level. This method is not only applicable to surfaces of any size but the sensitivity of the test may easily be varied to suit the purpose in view. As regards the ultimate accuracy which may be attained by this method, it has been proved capable of detecting errors in flatness as small as 0·000 1 mm in a lapped plate about 300 mm in diameter.

A-1.2 The method of assessing the error of flatness of a surface by using a spirit level is to measure the contour of the surface along a number of lines which form a network covering the total surface. The

measured contours are then, by means of calculation, all related to a common arbitrary plane, thus making it possible to assess the general overall errors of flatness of the surface The minimum requirement for this test is to measure a series of six symmetrically-spaced lines, namely, *ab*, *ac*, *cb*, *ad*, *bd* and *cd* as illustrated in Fig. 1.

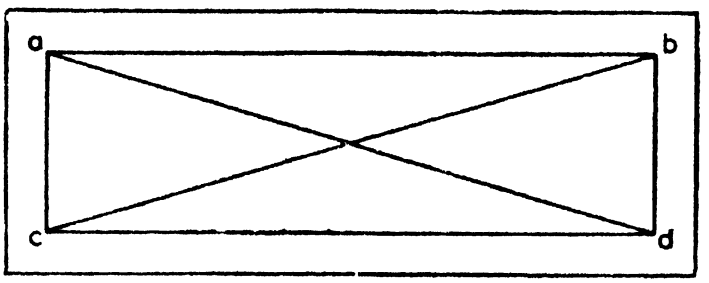

FIG. 1

A-1.3 Contours measured along additional lines will clearly give a greater number of points on the surface from which the errors of flatness of the surface may be assessed.

A-1.4 To determine the contour along any given line, the level is placed at one end of it and the position of one end of its bubble is read on its scale. The level is then advanced along the line through a distance equal to the span of its feet and second reading of the same end of the bubble is taken. In this way the level is advanced step by step along the line until the other end is reached; the level should then be moved backwards over the same path to obtain a check series of readings terminating at the starting position.

A-2. Comparative Method with the Surface Gauge

A-2.1 When a fairly large surface plate of good quality and known accuracy is available, it may be used as a basis for quicker tests on smaller plates up to Size No. 1 as illustrated in Fig. 2. The smaller plate is placed upon the larger one with a small toolmaker's jack under each support. A sturdy surface gauge having a good flat base of ample size and fitted with 0·001 mm indicator is used as the comparator. This is placed upon the larger plate with the indicator resting on the smaller one, the contact point of the indicator being provided with a swivelling pad about 20 mm in diameter in order to straddle over the scraping marks.

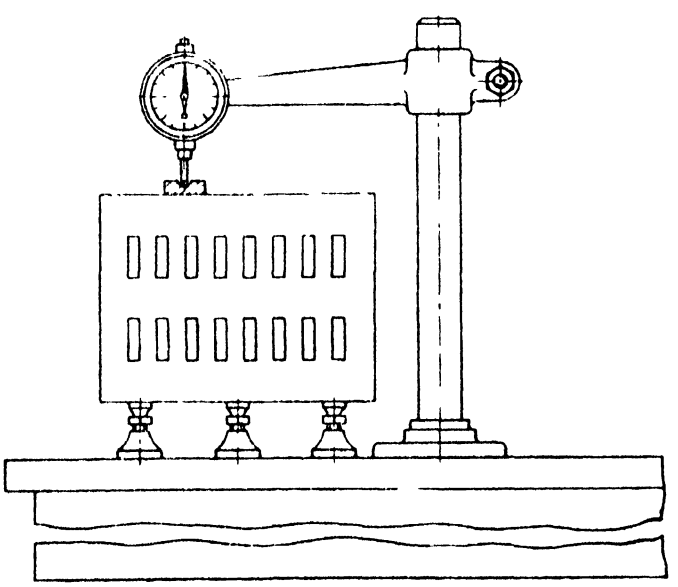

FIG. 2 COMPARATIVE METHOD WITH SURFACE GAUGE

A-2.2 Using the surface gauge and the jacks, the smaller plate is set parallel to the base in the regions above the three supporting feet. The surface gauge is then moved about so as to pass the indicator over the surface of the smaller plate. Any variations in the indicator reading then gives a direct measurement of the errors in flatness of the smaller plate.

A-3. Determination of the Proportion of Bearing Area

A-3.1 In order to determine the proportion of the bearing area of a scraped plate, its surface is first blued and rubbed with another plate so that the small bearing areas are brought up clearly into view. A small glass plate* on which an area of 50 × 50 mm has been ruled into 400 smaller squares (2·5 × 2·5 mm)† is then placed upon the surface. Each small square is then observed in turn and a note made of the estimated fraction of its area (in tenths) which is occupied by a 'high spot' on the surface underneath.

A-3.2 The addition of all these fractions when divided by four gives the percentage of the bearing area of the surface over the region tested. The test may be repeated at other positions on the surface in order to obtain a fair average figure.

A-3.3 It may be mentioned that after testing a few plates by this method, the results obtained, coupled with the general appearance of the bearing areas, enable a fairly close estimate to be made of the proportion of bearing area of a plate merely from its general appearance.

A-4. Straightedge Method of Testing Flatness

A-4.1 *Principle* The flatness of a surface can be determined by means of exploring generators for straightness and correlating them to a common plane. This can be done by employing a straightedge and slip gauges.

A-4.2 *Procedure* -- Prior to the assessment of the flatness of any surface, the accuracy of straightness of the working faces of the straightedge with reference to a master surface must be determined by the method as detailed in Appendix A of IS : 2220 1962 'Specification for steel straightedges'. The error in straightness of the straightedge has to be taken into account for computation of flatness.

The straightedge is placed on its edge over the surface to be assessed on two equal slip gauges supported at its minimum deflection points, which are apart by 5/9 × total length, leaving an equal overhang at either end (*see* **2.4** of IS : 2220 1962), at positions *AB*, *CD*, *BC* and *AD* as shown in Fig. 3. The gap between the bottom working face of the straightedge and the test surface is measured by slip gauges. The readings are taken at the same pitch length as employed for checking the straightness of the straightedge These readings are corrected according to the error in the straightedge. The corrected readings are then related to a common arbitrary plane by means of calculation and with reference to this arbitrary plane the flatness of the surface is assessed.

The length of the straightedge depends on the dimensions of the box angle plate. The recommended length of the straightedges are given in Table 4.

TABLE 4 RECOMMENDED LENGTHS OF STRAIGHTEDGES

Size of Box Angle Plate	Dimensions *L* × *B* × *H* (In mm)	Length of Straightedge According to IS : 2220-1962 (In mm)	
		Working Length	Total Length
1	125 × 75 × 100	160	180
2	175 × 100 × 125	300	340
3	250 × 150 × 175	300	340
4	350 × 200 × 250	500	540
5	450 × 300 × 350	500	540
6	600 × 400 × 450	800	840

Example:

Measurement of flatness of the surface of a Cast Iron box angle plate of size 350 × 200 × 250 mm using Grade A straightedges of length 500 mm.

The straightness of the straightedge is checked using a master surface plate, with the straightedge supported at the points of minimum deflection, that is, at 120 mm

*These glass plates can readily be produced like lantern slides by photographing a chart drawn on paper.

†The exact size of the square is unimportant provided that all the squares are of the same size.

from either end, on two equal slip gauges The readings in μm are noted with the help of slip gauges at pitch length of 75 mm. Actual readings are as shown in Fig. 3 The error in straightness of straightedges as shown in Fig 3, has to be taken into account for computation of flatness The straightedge is then placed on the box angle plate, on its edge supported by two equal slip gauges at its minimum deflection points Measurements are taken in two horizontal section *AB* and *CD* (along 350 mm side) and along two diagonals *AD* and *CB* The readings in μm taken at the same pitch lenghts along sections *AB CD*, *AD* and *CB* are as follows.

These readings are computed as follows

Section	Actual Readings	Readings on Straight-edge	Corrected Values	Section	Actual Readings	Readings on Straight-edge	Corrected Values
	0	0	0		0	0	0
	2 5	1	+1 5		1	1	0
AB	3 5	3	+0 5	*AD*	3	3	0
	2	2	0		1	2	−1
	0	0	0		0	0	0
	0	0	0		0	0	0
	2	1	+1		1	1	0
CD	3 5	3	+0 5	*CB*	2	3	1
	2	2	0		1	2	1
	0	0	0		0	0	0

The corrected values are manipulated to refer to a plane passing through 3 points on the face that is, passing *C*, *D* and *B*

Along *CB*	Along *CD*	Along *AD*	Along *AB*	Bringing E to 1 along *AD*	Bringing A to 2 along *AB*	Along *CD*
0(*C*)	0(*C*)	0(*A*)	0(*A*)	0(*D*)	2(*A*)	0(*C*)
0	+1	0	+1 5	−0·5	0	+1
−1(*E*)	+0 5	0(*E*)	+0 5	1(*E*)	0 5	+0 5
−1	0	−1	0	−2 5	0 5	0
0(*B*)	0(*D*)	0(*D*)	0(*B*)	−2(*A*)	0(*B*)	0(*D*)

Therefore,

Flatness of the face of the box angle plate = Maximum of minus reading + Maximum of plus reading

= 2·5 + 1

= 3·5 μm

Note — For measurement of flatness on sections along 250 mm and 200 mm size, the points of support may be shifted towards the centre of the straightedge without affecting the accuracy of measurement provided the length of working the straightedge is less than 900 mm. However, this shifting should be as minimum as possible

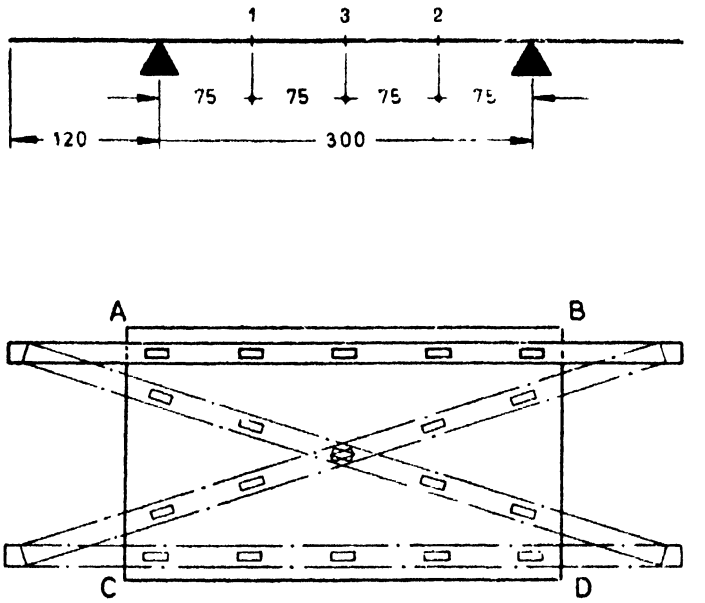

FIG. 3 STRAIGHTEDGE METHOD OF TESTING FLATNESS

EXPLANATORY NOTE

The box angle plates were originally covered along with angle plates in IS : 2554-1963 ' Specification for cast iron angle plates ' Consequent upon the revision of IS : 2554, box angle plates are being covered separately as now given in the present standard. In Appendix A the straightedge method of testing flatness of cast iron box angle plates has been incorporated.

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